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**HOẠT ĐỘNG XUẤT KHẨU CÁC MẶT HÀNG ĐIỆN TỬ VÀ LINH KIỆN ĐIỆN TỬ CỦA VIỆT NAM SANG CÁC ĐỐI TÁC THUỘC EVFTA: PHƯƠNG PHÁP TIẾP CẬN BẰNG MÔ HÌNH TRỌNG LỰC**

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**Tóm tắt**

Nghiên cứu này đánh giá tác động của Hiệp định Thương mại Tự do Việt Nam - EU (EVFTA) đối với xuất khẩu sản phẩm điện tử của Việt Nam. Nghiên cứu sử dụng mô hình trọng lực để đánh giá tác động của EVFTA và các yếu tố quyết định chính đến xuất khẩu điện tử của Việt Nam sang các đối tác EVFTA niêm yết, trong giai đoạn từ 2011 đến 2021. Dữ liệu bảng bao gồm thương mại giữa Việt Nam và 10 đối tác chính của EVFTA, trong đó có Pháp, Đức, Tây Ban Nha, Ý, Áo, Ba Lan, Bồ Đào Nha, Bỉ, Hà Lan và Ireland. Kết quả nghiên cứu cho thấy trong khi GDP của các thành viên EVFTA, việc giảm thuế theo EVFTA có tác động tích cực đáng kể đến kim ngạch xuất khẩu các sản phẩm điện tử của Việt Nam, độ mở thương mại, tỷ giá hối đoái Euro so với đồng Việt Nam được cho là có tác động tiêu cực đến biến phụ thuộc. Dựa trên những kết quả này, một số thảo luận và khuyến nghị đã được đưa ra nhằm hỗ trợ quá trình hoạch định chính sách và đạt hiệu quả cao hơn trong lĩnh vực xuất khẩu này, đặc biệt là trong khuôn khổ Hiệp định EVFTA.

**Từ khóa:** EVFTA, dòng chảy thương mại, xuất khẩu điện tử của Việt Nam, mô hình trọng lực

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# VIETNAM'S ELECTRONICS AND ELECTRONIC EQUIPMENTS EXPORT TO EVFTA PARTNERS: A GRAVITY APPROACH

## Abstract

This paper evaluates the effects of the EU-Vietnam Free Trade Agreement (EVFTA) on Vietnam's exports of electronics products. The study employed a gravity model to assess the impact of EVFTA and key determinants on Vietnam's electronic exports to listed EVFTA partners, over the period from 2011 to 2021. The panel dataset consists of trade between Vietnam and 10 major partner members of the EVFTA including France, Germany, Spain, Italy, Austria, Poland, Portugal, Belgium, Netherlands, and Ireland. The findings reveal that while GDP of EVFTA members, Tariff reduction under EVFTA have significantly positive impacts on the export turnover of Vietnam's exports of electronics products, trade openness, Euro to Vietnamese Dong exchange rate was found to negatively influence the dependent variable. Based on these results, some discussions and recommendations have been made to support the policy-making process and higher efficiency in this export sector, especially in the framework of the EVFTA Agreement.

**Keywords:** EVFTA, trade flow, Vietnam's electronic exports, gravity model

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## 1. Introduction

### *1.1. Overview of EVFTA agreement*

The European Union-Vietnam Free Trade Agreement (EVFTA), a comprehensive FTA between Vietnam and 27 EU member states, started on August 1, 2020. This is one of the major trade agreements for Vietnam and it supports cutting tariffs and easing non-tariff barriers.

In accordance with the Ministry of Industry and Trade and the General Department of Customs of Vietnam, the total trade turnover of goods between Vietnam and the EU (comprising 27 members) from 8/2020 to 7/2022 witnessed a continuous growth in terms of export. In the first 5 months of 2020 since EVFTA was implemented, export turnover from Vietnam to the EU has reached 15.62 billion USD, up to 3.8% over the same period in 2019. In 2021 and in the first 7 months of 2022, the export turnover from Vietnam to the EU has increased to 40.12 billion USD (14.1%) and 27.69 billion USD (21.39%) correspondingly. Thus, after two years of implementing the EVFTA, the total export turnover from Vietnam to the EU has successfully reached US\$83.4 billion, with an average of US\$41.7 billion per year (VCCI, 2022).

The EVFTA presents great opportunities for Vietnam's exports of electronics and electronic devices. By improving market access and creating fair competition, the agreement enhances chances to export to EU countries. According to the gravity model approach, trade volume are expected to rise because of these better conditions and stronger economic connections.

Moreover, the EVFTA promotes investment in Vietnam's electronics industry, enhancing technology and increasing production quality thereby improving export opportunities to the EU market. This shows how important it is for boosting Vietnam's electronics sector internationally.

## ***1.2. Overview of the Vietnam's electronic industry***

In recent years, Vietnam's electronics industry has experienced significant growth and transformation, emerging as a leading sector in the global market. Given factors such as the US-China trade dispute and rising manufacturing costs in China, Vietnam is becoming a prime destination for electronics trade. The strategic shift has made Vietnam a key player, benefiting from favorable economic conditions and strategic investments that enhance its competitiveness in the global electronics landscape. Vietnam's electronics exports have grown from an average of \$12 billion in 2014 to \$47.3 billion in 2019, placing the country 12th globally and 3rd in ASEAN (Vietnam Briefing, 2021). The major exports of Vietnam regarding the electronics sector include mobile phones, cameras, and television (41%), electrical apparatus (18.2%), and electronic integrated circuits and microassemblies (11.9%) (The Diplomat, 2021). In 2020, electrical machinery and equipment exports reached \$177.4 billion USD, accounting for 51% of Vietnam's overall export earnings (Vietnam Briefing, 2021). China was the largest export market for electronics, computer components, and other related products, valued at \$11.1 billion USD and representing 24.9% of the total export revenue for this commodity group, an increase of 16% over the previous year. Other main export markets also saw significant increases in revenue in 2020: the United States reached \$10.4 billion USD, up 71.7%; the European Union reached \$6.5 billion USD, up 28.7%; and Hong Kong reached \$4.2 billion USD, up 38.2% (General statistics office, 2021). A major factor contributing to the high growth is the skilled, yet cost-effective, workforce in Vietnam, supplemented by the government's investment in vocational training. Geographically, it is also located at an advantage from a logistics point of view, and the government has also invested heavily in the improvement of infrastructure to support the industry.

## ***1.3. Significance of the study***

This study is essential for understanding how Vietnam's electronics exports are influenced by the European Union-Vietnam Free Trade Agreement (EVFTA). Using a gravity model and advanced regression techniques, the research highlights how key economic factors—like GDP, trade openness, and exchange rates—affect export performance. The information obtained from the research will be very important data for policymakers and businesses, while clearly charting a roadmap on the way forward for improving Vietnam's export strategy. Through the use of EVFTA benefits and the way forward in keeping sustainable economic growth, Vietnam will thus be able to wade through the complexities of world trade and see its exports flourish amidst competition.

## ***1.4. Research objectives***

This study evaluated the economic factors that determine Vietnam's level of export of electronic products and equipment to EVFTA member countries. In particular, it studies the impact of GDP changes, exchange rate, trade openness and tariff reduction under EVFTA on export performance during 2011-2021. The analysis of major importing countries such as France, Germany, and Italy will attempt to track trends and provide more details on how to improve Vietnam's export competitiveness.

### ***1.5. Research questions***

- a. How do the GDP and trade openness of EVFTA member countries influence Vietnam's electronics exports according to a random effects gravity model?
- b. How have the tariff reductions in the EVFTA influenced Vietnam's exports of electronics and electronic equipment to the EU?
- c. How has Vietnam improved its electronics export strategy based on the results from the random effects gravity model analysis, and what policy recommendations help the country?

### ***1.6. Scope of the study***

This study attempts to analyze the effect of some economic variables on Vietnam's export of electronics and electronic equipment to EVFTA member countries. The dependent variable measured is export turnover, while a few independent variables such as each EVFTA member country's GDP ( $\ln gdp$ ), the exchange rate between EUR and VND ( $\ln exr$ ), trade openness ( $open$ ), and a dummy variable representing EVFTA agreement tariff reductions ( $evfta$ ), were considered. Covering the period from 2011 to 2021, the study utilizes export data from World Integrated Trade Solutions (WITS), GDP and trade openness data from World Bank Open Data, exchange rates from OFX, and EVFTA tariff data from the WTO Center. A cross-sectional time-series FGLS regression model is adopted to estimate the effects of these variables. The selection of countries for study from France, Germany, Spain, Italy, Austria, Poland, Portugal, Belgium, Netherlands, and Ireland, since they are the countries with large imports of electronic equipment from Vietnam through EVFTA.

## **2. Literature review**

### ***2.1. Previous studies of Vietnam's export under EVFTA***

Regarding Vietnam's trade efficiency, various studies have explored this topic across different sectors and time periods. Nguyen (2016) employed a gravity model to assess the impact of the EU-Vietnam Free Trade Agreement (EVFTA) on Vietnam's trade by using a panel dataset of 28 European countries from 1997 to 2013. The findings indicated that tariff elimination positively influences bilateral trade between Vietnam and the EU. Specifically, a 1% reduction in tariffs would increase total trade flow by 0.52% for Vietnam and 0.95% for the EU. Additionally, thanks to the EU - Vietnam FTA and other FTAs that Vietnam has signed, investors will consider Vietnam as a production point to re-export to EU or other trading partners of Vietnam. Vietnam - EU FTA can also be a strong motivation for Vietnam to undertake institutional reforms and create a more transparent business environment.

Similarly, Vu Thanh Huong (2017) used a gravity model to evaluate the impact of EVFTA on two product groups including clothing and pharmaceuticals. The author has built a framework for diagnosing the impact of EVFTA, including 4 sets of indicators, 11 factors and 23 indicators. There is also a SMART methodology that can quantify the impact of EVFTA on total trade and trade

across 18 industry groups, as well as qualitatively analyze the impact of fluctuations in non-tariff goods on trade. Vietnam-European Union trade. The study concluded that tariff reduction is one of the main factors promoting bilateral trade between Vietnam and the EU. After Vietnam reduced tax by 1% on goods imported from the EU, Vietnam - EU trade increased by 3.84%; When the EU reduced tariffs on imported goods from Vietnam by 1%, based on the REM estimation results of the gravity model, Vietnam-EU trade increased by 1.69%.

Nguyen and Doan (2017) also utilized a gravity model to evaluate the correlation among datasets and assess the impact of various factors on Vietnam's trade with EVFTA partners. However, unlike the traditional gravity models used by Nguyen (2016) and Vu Thanh Huong (2017), Nguyen and Doan (2017) introduced the Stochastic Frontier Gravity Model (SFGM) to analyze the determinants of Vietnam's trade efficiency. The study covered Vietnam's trade efficiency with 30 partners, including both ASEAN and non-ASEAN countries, over an 11-year period (1995–2015). Their two-step estimation revealed that Vietnam's trade efficiency was relatively low, particularly with EU and NAFTA countries. In 2015, Vietnam's export and import efficiencies with the EU averaged only 21.21% and 19.78%, respectively.

In addition to the aforesaid study, Doan and Xing (2018) used the SFGM two-step estimation to analyze Vietnam's export efficiency with its 28 importers from 1995 to 2013. Their findings indicate a significant improvement in Vietnam's export efficiency over this period, rising from 19.7% to 37.9%. On average, Vietnam achieved about one-third of its export potential with its EU partners, with the highest export efficiencies recorded with Belgium, the Netherlands, Germany, the UK, and France (61.28%, 59.26%, 43.48%, 40.63%, and 40.28%, respectively).

Nguyen and Wu (2020) used a two-step SFGM to estimate Vietnam's export efficiency and examine the impact of bilateral governance performance from 1996 to 2014. The results posit that while export efficiency is positively affected by bilateral governance indicators and regional trade agreements (RTAs), it is negatively affected by import tariffs. The researchers also applied a one-step approach developed by Battese and Coelli (1995) to estimate export efficiency scores and revealed an average export efficiency score of 48% for Vietnam.

## ***2.2. Previous studies of Vietnam's electronic export***

Pham Van Nho, Vu Thanh Huong (2014) applied the gravity model to assess the determinants of service trade flows between Vietnam and the European Union. The author estimated panel data and pooled them with random and fixed effects across a ten-year period from 2002 to 2011, for total service trade flows, service exports, and service imports between Vietnam and the EU. The findings show that service trade flows are influenced by the GDP per capita gap between Vietnam and EU nations, the population of EU countries, real effective exchange rates, colonial links, and previous participation in the Council of Mutual Economic Assistance.

Nguyen Thi Phan Thu and Dong Thi Kieu Trang (2020) also utilized the gravity model to evaluate the factors affecting Vietnam's participation in the global value chain of the electronic industry and analyze trade flows (total imports and exports) between Vietnam and 5 countries (China, USA, Korea, Hong Kong, Japan) in electronics. The result indicated that GDP per capita

(GDP) and infrastructure index have a positive effect on the total import-export turnover of the electronics industry. Through the test results, the author concluded FEM is the most suitable model used to analyze the impact of factors on the total import-export turnover of the electronics industry in Vietnam.

Hanh Song Thi Pham, Anh Ngoc Nguyen and Andrew Johnston (2020) conducted a comprehensive review and evaluation of various stakeholders in the industry, analyzing the policies implemented by the Vietnamese government during the period 1986–2017. They argue that while the policy aimed at promoting technological learning through spillovers from foreign direct investment achieved a certain level of technological development, implementation issues and institutional failures resulted in unintended consequences. The study concludes that trade liberalization alone did not achieve the desired technological advancement for domestic firms in Vietnam and provides policy implications for technological development in developing countries.

### **2.3. *Research gap***

Through extensive research on the impact of previous Free Trade Agreements (FTAs that have been in force on international trade lines, it is evident that there is a scarcity of studies focusing on the impact assessment of the European Union-Vietnam Free Trade Agreement (EVFTA) in a specific segment, especially ones that evaluate impacts of the EVFTA on trade flows of electronic products. This lack of research could potentially be attributed to lack of detailed analysis on specific sectors like electronics and the effects of non-tariff barriers on electronic exports (Kocourek and Šímanová, 2018). Thus, to fill this gap, this research will adopt the gravity model approach to provide a comprehensive evaluation of how the EVFTA potentially affects Vietnam's export of electronics to the EU.

## **3. Research methodology**

### **3.1. *Data collection***

Our group gathered information on ten major importers of machinery and electronic equipment from Vietnam who are participants of the EVFTA during the period 2011-2021, including France, Germany, Spain, Italy, Austria, Poland, Portugal, Belgium, Netherlands, and Ireland. One dependent variable and four independent variables—one of which is a dummy variable—make up the data set. Our model contains 110 observations in total.

Data for the analysis was collected from reputable international sources. World Integrated Trade Solutions provided the export turnover of machinery and electronic equipment from Vietnam to each EVFTA member, the sole dependent variable in the model. Trade openness and GDP of each EVFTA member, the independent variables, were obtained from World Bank Open Data. In addition, exchange rates between EUR and VND during the period 2011-2021 were collected from OFX. Furthermore, the dummy variable was obtained from the WTO Center, and it is derived from the tax that each nation imposed on Vietnam's electronic goods.

### 3.2. Methodology

#### 3.2.1. Gravity model in international trade

The gravity model in international trade is a fundamental concept that helps explain and predict trade flows between countries. Just like gravity attracts objects with mass, the gravity model suggests that countries with larger economic sizes and closer geographical proximity are naturally drawn to trade with each other.

The equation of gravity model is expressed as follows:

$$F_{ij} = \frac{GDP_x^\alpha \cdot GDP_y^\beta}{D_{xy}^\theta} \quad (1)$$

where  $F_{ij}$  demonstrates the amount of bilateral trade flows between nation x and nation y.;

G is the gravitational constant;

$GDP_x$  is the gross domestic product of the country x;

$D_{xy}$  is the distance between the capitals of country x and country y.

The gravity model of trade (1) takes the following form after the equation is linearized using the logarithm function:

$$\ln (F_{ij}) = \beta_0 + \beta_1 \ln (GDP_x) + \beta_2 \ln (GDP_y) - \beta_3 \ln (D_{xy}) + \varepsilon_{ij} \quad (2)$$

$\beta_0, \beta_1, \beta_2, \beta_3$  represents the coefficients to be estimated.

Error term  $\varepsilon_{ij}$  accounts for additional unexplained variables that impact bilateral trade between the country x and country y.

From the equation (2), it is expected that trade will have a positive relationship with the gross domestic products of countries and a negative relationship with distance.

#### 3.2.2. Regression model

$$\ln (EXP)_{it} = \beta_0 + \beta_1 \ln (GDP)_{it} + \beta_2 \ln (EXR)_{it} + \beta_3 (OPEN)_{it} + \beta_4 (EVFTA)_{it} + \varepsilon$$

Where  $\ln (EXP)_{it}$  is logarithm function of Vietnam's export of electronics and electronic equipments to listed countries under EVFTA in year t;

$\ln (GDP)_{it}$ : the logarithm function of GDP of importing country i's GDP at year t;

$\ln (EXR)_{it}$ : the exchange rate between Euro and VND on the final day of year t;

$OPEN_{it}$ : the percentage of trade in GDP of the importing country t;

$EVFTA$ : has the value of 1 if the EVFTA is in effect, or 0 otherwise;

$\varepsilon$ : error terms accounts for additional unexplained variables;

$\beta_0, \beta_1, \beta_2, \beta_3$ : coefficients to be estimated.

**Table 1:** Measurements of Variables

Variable	Description	Measurement	Source	Expected sign
Dependent variable				
<b>EXP<sub>it</sub></b>	Vietnam's export of electronics and electronic equipments to listed EVFTA partners in year t	Thousand USD	WITS	
Independent variable				
<b>GDP<sub>it</sub></b>	The Gross Domestic Product of the importing country in year t	Billion USD	World Bank	+
<b>EXR<sub>it</sub></b>	The Exchange Rate between Euro and Vietnam Dong on the final day of year t	Euro to VND	OFX	-
<b>OPEN<sub>it</sub></b>	The percentage of trade in GDP of the importing country	%	World Bank	-
<b>EVFTA<sub>it</sub></b>	EVFTA agreement between Vietnam and the importing country (related to average tariff)	1 if the EVFTA is in effect, or 0 otherwise	WTO	+

In addition to the factors mentioned above, it is important to note that the model in this study does not contain the independent variable "Distance" because using distance as a proxy for the actual geographic distance between capitals in panel data can result in biases.

### **3.3. Research hypothesis**

A review of a wide range of earlier research articles revealed a scarcity of studies examining the impact of the European Union-Vietnam Free Trade Agreement (EVFTA) on Vietnam's machinery and electronic goods exports, using the stochastic gravity approach and providing a solid basis for establishing the tariff and export volume hypothesis (Nguyen, T. D. et al, 2024). Consequently, the hypotheses are deployed based on past research analyzing significant variables influencing Vietnam's exports of industrial and electronic goods.

The economic strength of European Union Free Trade Agreement (EVFTA) members plays a significant role in fostering Vietnamese machinery and electronic equipment exports. According to a study by Vu Thanh Huong in 2017, a positive correlation exists between the GDP of an EVFTA member and Vietnam's exports of machinery and electronics to that country (Vu, T. H.

et al, 2017). This aligns with economic theory suggesting that increased economic activity in an importing nation leads to higher demand for various goods, including machinery and electronics (Krugman et al., 2018). EVFTA member countries with larger GDPs tend to have a greater capacity for consumption and investment, creating a more robust market for Vietnamese exports. This highlights the importance of the EVFTA in facilitating market access and potentially boosting Vietnam's economic growth through increased exports (World Bank, 2021). From these findings, we can conclude that:

*H1: GDP of EVFTA members positively influences the export of machinery and electronic equipment of Vietnam to European countries*

It is possible that there is a more complex relationship than first appears between trade openness and Vietnam's exports of machinery and electronic equipment to EVFTA partners. According to an empirical study by Hye and Lau, the trade openness index has a long-term negative effect on economic growth (Hye and Lau, 2012). Abdulkarim discovered that while trade liberalization may benefit some countries more than others due to endowments, market flaws, and technological disparities, trade openness actually improves economic efficiency (Abdulkarim, 2023). This surprising conclusion implies that there may be more competition for Vietnamese goods in the more trade-open economies included in the EVFTA. Lower export volumes may result from tougher competition for Vietnam's exports when these nations have robust trade relations with other major exporters or have well-developed machinery and electronics sectors of their own. To obtain more insights about these impacts, the following hypothesis is proposed:

*H2: Trade openness of EVFTA partners negatively affects Vietnam's machinery and electronic equipment exports*

Government officials in Vietnam claim that the EU and Vietnam have agreed on a deadline for liberalizing all tariffs. One of the most important of these pledges is a seven-year plan tariff reduction for Vietnamese machinery and electronic equipment export. In 2018, the sector's exports came to approximately US\$9 billion. Given those machinery and electronic products items including cell phones, computers, electronic components make up a sizable share of Vietnam's exports to the EU, the FTA has the potential to greatly expand trade volume between the two countries (Vietnam Ministry of Foreign Affairs, 2020). To determine this conclusion, there evolves the following hypothesis:

*H3: Tariff reduction under EVFTA positively impacts Vietnam's machinery and electronic products exports*

The findings indicate that there is a negative correlation between exchange rate and trade balance because exchange rate volatility often has a large negative impact on import and export with lag (Poon & Hooy, 2013). Vietnamese exporters of electronics and machines to the EU face substantial challenges as a result of a strong euro. Essential raw materials, which are frequently purchased in euros, become more costly for Vietnamese firms due to the growing euro. As a result, their profit margins are squeezed and they find it more difficult to compete with manufacturers in

nations where currencies are weaker. From the existing analysis above, we can state the following hypothesis:

*H4: Euro to Vietnamese Dong exchange rate negatively impacts Vietnam's export of machinery and electronic equipment exports*

## 4. Discussion and result analysis

### 4.1. Testing model defects

After running OLS regression analysis, we test the model to check for multicollinearity error by applying a statistical tool called Variance Inflation Factor. Using the command **vif**, the result is presented below:

Variable	VIF	1/VIF
ln_gdp	<b>1.35</b>	<b>0.743139</b>
open	<b>1.34</b>	<b>0.743522</b>
evfta	<b>1.02</b>	<b>0.976203</b>
ln_exr	<b>1.02</b>	<b>0.982993</b>
Mean VIF	<b>1.18</b>	

**Figure 1:** Multicollinearity check on Stata

As interpreted in the preceding figure, there is no evidence of multicollinearity for any of the variables because the mean VIF is less than 5, at 1.18. Thus, we can say that there is not a serious multicollinearity problem with the model.

Next, our team determines which of the fixed-effects and random-effects models is better using the Hausman test. A p-value is provided by the Hausman test. The chance of witnessing the test statistic is represented by this p-value.

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
	(b) fixed	(B) rand		
ln_gdp	<b>2.815581</b>	<b>1.618832</b>	<b>1.19675</b>	<b>.7637066</b>
ln_exr	<b>-6.913411</b>	<b>-5.898394</b>	<b>-1.015017</b>	<b>.7809448</b>
evfta	<b>.3616168</b>	<b>.4841833</b>	<b>-.1225666</b>	<b>.036102</b>
open	<b>-.0035507</b>	<b>.0031381</b>	<b>-.0066888</b>	<b>.0087066</b>

b = Consistent under H0 and Ha; obtained from **xtreg**.  
B = Inconsistent under Ha, efficient under H0; obtained from **xtreg**.

Test of H0: Difference in coefficients not systematic

$\chi^2(4) = (b-B)'[(V_b-V_B)^{-1}](b-B)$   
= **8.19**  
Prob >  $\chi^2$  = **0.0848**  
(V\_b-V\_B is not positive definite)

**Figure 2:** Result of Hausman test on Stata

According to the Hausman test as above, the p-value observed is 0.0848, which is above 0.05. This result indicates that we fail to reject the null hypothesis (H0: The random-effects model is efficient) and suggests that the random-effects model is more appropriate than the fixed-effects model.

#### 4.2. Heteroskedasticity and autocorrelation test on the random-effects model

After running the Hausman test and obtaining the result that the random-effects model is a preferable approach, our group then tested the random-effects model to check for heteroskedasticity and autocorrelation defects.

By using the command **xtserial**, our group achieve the below result:

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
      F(   1,      9) =      31.914
      Prob > F =      0.0003
```

**Figure 3:** Autocorrelation defect checking on Stata

The Woolridge test shows that the index is 0.0003, which is below 0.05, suggesting that there is a sign of autocorrelation in the model which needs to be corrected.

Next, we apply the Breusch and Pagan Lagrangian multiplier test to check if the model is free from heteroskedasticity defects or not. Running the command **xttest0**, the following result is observed:

```
Breusch and Pagan Lagrangian multiplier test for random effects

lnexp[name,t] = Xb + u[name] + e[name,t]

Estimated results:
      +-----+-----+
      |               Var               SD = sqrt(Var)
      +-----+-----+
      | lnexp      2.576693      1.605208
      | e          .2264843      .4759036
      | u          1.407288      1.186292
      +-----+-----+

Test: Var(u) = 0
      chibar2(01) =      335.51
      Prob > chibar2 =      0.0000
```

**Figure 4:** Heteroskedasticity test on Stata

It can be clearly seen in the figure that the Prob > chibar2 value is 0.000, which is below 0.05, resulting in the rejection of the null hypothesis. Therefore, we conclude that there exists heteroskedasticity defects in our model, which may have to be corrected later.

#### 4.3. Model estimation results

The study analyzed the impact of Vietnam's non-tariff measures, from the perspective of EVFTA impacts on electronics export flows. The author utilized many different estimation methods for cross-sectional data by product and tested the appropriateness of the model. With the characteristics of 0 commercial value data and independent variables with variable error variance,

the test results show that the maximum likelihood estimation method (PPML) of Santos Silva & Tenreyro (2006) is the most suitable. Some estimation results show some basic implications as following.

As heteroskedasticity and autocorrelation defects are found when testing for model defects in the above section, the FGLS regression method is applied in order to address the defects mentioned. FGLS appears to be the most appropriate approach when estimating the gravity model results.

Cross-sectional time-series FGLS regression						
Coefficients: <b>generalized least squares</b>						
Panels: <b>homoskedastic</b>						
Correlation: <b>no autocorrelation</b>						
Estimated covariances	=	<b>1</b>	Number of obs	=	<b>110</b>	
Estimated autocorrelations	=	<b>0</b>	Number of groups	=	<b>10</b>	
Estimated coefficients	=	<b>5</b>	Time periods	=	<b>11</b>	
Log likelihood	=	<b>-168.4094</b>	Wald chi2(4)	=	<b>114.47</b>	
			Prob > chi2	=	<b>0.0000</b>	
lnexp	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
lngdp	<b>.7541156</b>	<b>.1340108</b>	<b>5.63</b>	<b>0.000</b>	<b>.4914593</b>	<b>1.016772</b>
lnexr	<b>-5.898684</b>	<b>2.178558</b>	<b>-2.71</b>	<b>0.007</b>	<b>-10.16858</b>	<b>-1.628788</b>
evfta	<b>.731565</b>	<b>.3754842</b>	<b>1.95</b>	<b>0.051</b>	<b>-.0043705</b>	<b>1.4675</b>
open	<b>-.0113893</b>	<b>.0024653</b>	<b>-4.62</b>	<b>0.000</b>	<b>-.0162212</b>	<b>-.0065574</b>
_cons	<b>58.90594</b>	<b>22.34047</b>	<b>2.64</b>	<b>0.008</b>	<b>15.11943</b>	<b>102.6925</b>

**Figure 5:** FGLS regression estimated results

In light of the findings, the p-value for GDP and trade openness is 0.000, which is less than 0.05. This shows that these two variables are found to be statistically significant and influence Vietnam's exports of machinery and electronic equipment at a significance level of 1%. Comparably, the exchange rate's p-value of 0.007, which is less than 0.05, indicates that this variable also has an impact on Vietnam's exports of machinery. On the other hand, the EVFTA's p-value is 0.051, which is extremely near to 0.05, suggesting that the tariff reduction is just marginally not significant. Though it falls short of the traditional threshold, it indicates a slight predisposition to reject the null hypothesis.

Under the FGLS method, the coefficient of GDP of importing countries is 0.7541156, which is positive as expected. This result supports conclusions of (Vu, T. H. et al, 2017) and (Krugman et al., 2018) and is in line with our research hypothesis aforementioned.

The coefficient of exchange rate is -5.898684, which is negative as expected in the research hypothesis. This indicates a strong inverse relationship between exchange rate and export of machinery products of Vietnam.

In terms of trade openness, our group collects the coefficient of -0.0113893. This means that a 1% increase in trade openness of importing countries (other factors remain constant), Vietnam's export turnover of machinery and electronic equipment will decrease by 1.13893%, which, in fact, proved the findings of (Abdulkarim, 2023) and (Hye and Lau, 2012).

Finally, the FGLS regression coefficient for dummy variable, EVFTA, is 0.731565, indicating a positive relationship between tariff reduction under EVFTA and Vietnam's export of machinery and electronic equipment. This results that the estimated result is in compliance with our proposed research hypothesis number 3 (H3): Tariff reduction under EVFTA positively impacts Vietnam's machinery and electronic products exports.

## **5. Conclusion and recommendations**

The research conducted by the group of authors aims to assess the effect of EVFT on Vietnam electronics and electronics equipment export. To sum up, Vietnam's exports of electronics and electronic equipment are positively impacted by the GDP of EVFTA member nations and the tariff reductions under the agreement, while importer countries' trade openness and the exchange rate between Euro and Vietnam Dong have negative effect. However, the research has the limitation that we have limited ability in access to the export and import data related to specific electronics and electronics equipment between Vietnam and EVFTA members. Thus, future research with more specific data should be conducted to give a more detailed picture of EVFTA and Vietnam's electronics and electronic equipment export. Furthermore, there are techniques for estimating the gravity model that cannot be considered in this study and the time frame, which came into effect in 2020, might be not long enough for us to evaluate totally.

The Vietnamese government play a crucial role in amplifying electronics exports to the Eurozone under the EVFTA. Specifically, the government should review and enhance legal policies, particularly those pertaining to specific regulations on goods originating in Vietnam, to facilitate the development of export activities of electronics and electronic products in the context of Vietnam's integration with the EVFTA. In order to lower costs and remove administrative obstacles for exporters, they should also fully optimize the benefits of the EVFTA by putting trade facilitation measures into place, such as streamlining customs processes and laws to speed up the flow of electronics goods between Vietnam and the EU. The state should establish funding programs and tax breaks that incentivize research and development in the Vietnamese electronics sector. This can encourage innovation in areas like cleaner technologies and miniaturization, which resonate with European consumers. Moreover, partnerships between Vietnamese and European companies should be facilitated more through programs and events as this can promote technology transfer and knowledge sharing, accelerating the adoption of advanced manufacturing processes in Vietnam.

Not only the authority but domestic enterprises should take immediate actions to develop the export of electronics and electronic equipment into Europe under EVFTA. European consumers prioritize quality, safety and compliance with environmental standards. Therefore, Vietnamese

businesses need to ensure their products meet EU regulations and certifications. In addition, implementing strict quality control procedures is necessary to maintain stable product quality. Additionally, allocating resources to research and development (R&D) activities will help improve product design, functionality and innovation. Experts recommend that Vietnam should develop an electronics industry with high added value. Instead of just assembling and processing simple products, businesses need to invest in research, development, and innovation to create complex electronic goods that meet the needs of the European market. Ultimately, upskilling the workforce is essential to meet the demands of a high-tech industry. This can be achieved through collaboration with educational institutions and vocational training centers to develop specialized skills.

Finally, there are some suggestions for Vietnam Electronic Industries Association (VEIA) to enhance its role and position which support the export of electronics & electronics equipments. VEIA should continue to act as an supportive intermediary in connecting electronics enterprises as they can share their partners, experience and business opportunities. Simultaneously, the cooperation between VEIA and state-own management agencies and science & technology organizations should be improved vertically and horizontally. VEIA needs to promote training programs on management, technical, marketing, ... for electronic businesses to improve business capacity as well as support them in applying technology to production and management activities. In addition, to expand international markets, VEIA needs to implement trade promotion campaigns to mark the Vietnamese electronic products in international customers' mind as well as prove that Vietnam has the enormous potential to be the market leader in this industry.

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